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IS 9080-4 (1981): Safety requirements in electro-heat installations, Part 4: Particular requirements for arc furnace installations [ETD 17: Industrial Electroheating Equipment]

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Indian Standard
SAFETY REQUIREMENTS IN
ELECTRO-HEAT INSTALLATIONS

PART IV PARTICULAR REQUIREMENTS FOR
ARC FURNACE INSTALLATIONS

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Indian Standard
**SAFETY REQUIREMENTS IN
ELECTRO-HEAT INSTALLATIONS**
**ART IV PARTICULAR REQUIREMENTS FOR
ARC FURNACE INSTALLATIONS**

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*Indian Standard***SAFETY REQUIREMENTS IN
ELECTRO-HEAT INSTALLATIONS****PART IV PARTICULAR REQUIREMENTS FOR
ARC FURNACE INSTALLATIONS****0. FOREWORD**

0.1 This Indian Standard (Part IV) was adopted by the Indian Standards Institution on 13 January 1981, after the draft finalized by the Industrial Electro-heating Equipment Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This part dealing with particular safety requirements for direct arc furnaces and submerged arc furnaces forms Part IV of the series. The other parts of this standard are:

- Part I General requirements
- Part II Particular requirements for resistance heating equipment
 - Sec 1 Protection in direct resistance heating installations
 - Sec 2 Protection in indirect resistance heating installations
 - Sec 3 Protection in potassium and sodium nitrate and nitrite bath furnaces
 - Sec 4 Protection in installations used for drying varnishes and other similar products
- Part III Particular requirements for mains and medium frequency induction furnace installations

0.3 In preparing this standard, assistance has been derived from IEC Publication 519-4(1977) 'Safety in electro-heat installations: Part IV Particular requirements for arc furnace installations' issued by International Electrotechnical Commission.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard (Part IV) covers the safety requirements of arc furnace installations, for example, direct arc furnaces and submerged arc furnaces.

1.2 This standard also applies to that part of the installation which is situated on the output side of the furnace feeding transformer. This part of the installation comprises: the furnace itself, its foundation and structure, its electric equipment from the low voltage terminals of the transformer to the electrodes, the operating and control apparatus of the furnaces and all other equipment inherent in the utilization of the furnace.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions given in IS : 9080 (Part I)-1979* shall apply.

3. CONSTRUCTION AND INSTALLATION DETAILS

3.1 Electrodes and Their Auxiliaries

3.1.1 The electrode holding structure shall be insulated from the drive mechanism and from the furnace frame. The frame and the drive mechanism shall be earthed through the supporting frame if the latter ensures a satisfactory low earth resistance.

3.1.2 The electrode-moving system shall be provided with limit switches and end-of-travel stops.

3.1.3 The electrode guide system, if independent of the contact plates (in particular for submerged arc furnaces), shall be of the kind which locks the electrode with its holder when the guide system is not being operated.

3.2 Furnace Shells and Roof

3.2.1 The metal-clad shells shall be earthed either directly or by connecting them to the metal support which is also earthed, provided the earth resistance is low enough.

3.2.2 Tilting-type shells shall be provided with limit switches of devices at both ends of the travel (this clause is not applicable for hydraulic tilting systems employing cylinders with restricted travel length).

*Safety requirements in electro-heat installations: Part I General requirements.

3.2.3 Furnaces with a rotating and tilting shell shall be equipped with an interlocking system to prevent operation of the tilting device of the shell if the pouring spout is not its appropriate position.

3.2.4 Basket-loaded furnaces shall embody a mechanism which, at the end of the swing-aside roof movement, locks the controlling device of the roof displacement in its final position.

3.2.5 The rotating and displacement devices of the shell and of the roof shall be interlocked with the electrode moving system to ensure that these movements are possible only when the electrode columns are in their upper position.

3.2.6 For furnaces provided with an induction charge mixer, interlocks should be applied which will allow only for the switching-on of its electric supply when the charge window of the furnace has been closed, the roof covering completely the furnace shell and the electrodes raised.

3.2.7 Access to the super-structures of a furnace shall be possible only after the operation of appropriate devices to switch-off power (for instance, the opening of a door or lifting of a bar causing the switch-off of the furnace and to maintain it out of operation). A warning notice 'Entry forbidden — Furnace alive' should be provided.

However, in certain particular cases, for example, when working on self-sintering electrodes of submerged arc furnaces it might be necessary to have access to the super-structures whilst the furnace is in operation. Under these conditions, the requirements of **16.2** of IS : 9080 (Part I)-1979* should be met.

3.2.8 The state of the furnace (switched on or switched off) shall be indicated by lamps so situated as to be visible to personnel located in the work areas.

3.2.9 When tilting the furnace in the direction of the casting shop, indication by optical and acoustic devices should be given, these respective signals being clearly seen within the casting shop itself.

3.2.10 Electrode economizers, which may be water-cooled, shall have retaining chains or a system to prevent them from falling into the charge should the arc furnace roof collapse (in all cases, these systems shall be electrically insulated from earth).

3.2.11 Furnaces shall be provided with a mechanism to lift electrodes in the case of electrical supply interruption.

*Safety requirements in electro-heat installations: Part I General requirements.

3.3 Loading Tapping and Casting

3.3.1 The part of the taphole piercing electrode in contact with the operator shall be suitably electrically insulated.

3.3.2 Operators required to handle tools or any metallic instruments in contact with live parts shall be electrically insulated from both the tool and earth by suitable garments, for example, gloves and shoes.

3.3.3 The loading machines, being an integral component of the furnace installation, should be earthed or suitably electrically insulated. In the latter case, the personnel responsible for the operation shall be informed accordingly.

When using loading devices independent of the furnace installation, (for example, loading tractors on rubber wheels), protective devices and precise operation regulations should be foreseen to eliminate any hazard for personnel entrusted with the servicing of these devices.

3.4 Installation Requirements

3.4.1 The presence of water in the tapping area shall be avoided. Measures shall be taken to drain any water away from the tapping area in the event of a leakage.

NOTE — This requirement is not applicable to furnaces for special use. In this case, special safety provisions shall be observed in order to avoid explosion hazard.

3.4.2 The various parts of the furnace requiring supervision and maintenance (electrical insulation, electrode carriers, economizers, servomotors, etc) shall be readily accessible by means of fixed ladders, platforms, catwalks and other fixed installations. All workplaces above ground shall be provided with railings.

3.4.3 Casting pits near the furnace intended for receiving the ladles during pouring of the molten metal shall be so built as to provide ample free inner space for ladle-handling; they shall also be surrounded by railings or be closed by covers when not in use. The evacuation of water shall be ensured.

3.4.4 Where pressurized gas storage tanks are installed in the vicinity of a furnace, provision shall also be made to protect them against possible overheating, electric discharges and splashing of incandescent substances. Similar safety precautions shall be taken for portable containers under pressure (carboys, etc).

3.4.5 When a key is used for switching on power to the furnace, its removal shall be possible only when in the switch-off position.

3.4.6 The switching-off of the furnace by means of push-buttons shall be possible from the operator's work area, whereas the switching-on shall be possible only from the main control panel located in the control room of the furnace.

3.4.7 It should be possible to switch on the furnace up to 15° tilted angle (both in forward and backward directions) for operational reasons. Interlocks should be provided for making it impossible to tilt the furnace with power on beyond 15°.

3.4.8 Earthing of a furnace shall be separated from other earthings of existing installations in the same building.

3.4.9 The electrodes may be positioned manually in order to clear the tips of metal surface before tilting the furnace by seeing through the slag-door.

NOTE 1 — In the case of installations of furnaces for duplexing, interlocks are to be positioned so as to allow forward tilting of the furnace up to a maximum of 15° with power switched on.

NOTE 2 — Interlocks are to be positioned to allow back tilting (slagging off) or the furnace up to 15° maximum with power switched on.

4. OPERATION

4.1 The furnace operators shall wear suitable protective clothing and have at their disposal suitable means of protection for performing the various furnace operations, such as insulated shoes (wooden-soled clogs or rubber-soled shoes without metal nails), helmets, heat-protecting masks, aprons, insulated gloves, blue-tinted goggles, insulated gang-planks of such dimensions as to permit the performance of the relevant operations in complete safety.

NOTE — Attention is drawn to the necessity of ensuring, in certain cases, protection against noise by appropriate measures (helmets, etc) being made available for personnel servicing the arc furnaces.

4.2 During the fitting and welding of the casings of self-baking electrodes, the loading of the electrode paste and the fitting of the electrodes, the operators shall be suitably insulated from the ground and earthed structures and shall be positioned in a safety area. It should be ensured that the operators and the tools they use (for instance, welding devices) can come into contact only with a single electrode at a time. If such precautions cannot be complied with, extending of electrodes must be carried out with electric power to the furnace switched off.

4.3 If slipping of the electrodes (unclamping and reclamping of the contact plates and of the guide-channels) is carried out by hand, this should preferably be done with electric power to the furnace switched

off; however, if the current cannot be switched off, the operation shall be carried out only by operators provided with insulated shoes, gloves and tools, preferably under conditions specified in 4.2.

4.4 The operation of stirring with steel rabbles and the manipulation of the oxygen lance used for decarburizing the bath shall be carried out by operators wearing insulated shoes and gloves or they should otherwise be electrically insulated from earth.

When the deslagging is carried out under voltage by means of rabbles manipulated by hand from the outside, the operators shall be adequately electrically insulated from earth. It is advisable to rest the metal handle of the rabble on the metal structure of the furnace.

4.5 The shut-off devices of the oxygen supply pipe-line (taps or valves) for decarburizing the bath shall be so located as to be readily accessible to the operator in charge of the process and to be protected against splashes of molten metal or slag at the time of blowing oxygen. All the joints of the oxygen pipe-line shall be well sealed.

4.6 If the perforation of the tapping-hole is carried out electrically or by means of metal tools (pipe or rabbles) with voltage applied to the furnace, this shall be done only by operators wearing electrically insulated shoes and gloves and/or other protection devices as required.

4.7 The control of forward and back tilting of the furnace is to be such as to avoid spillage of the charge when pouring and deslagging.

4.8 Access to the furnace with power switched on shall be permitted only to authorized personnel.

4.9 Personnel shall be warned against gaining access to the area under the furnace platform, shell and flexible cables by means of a barrier or warning notices.

4.10 Before loosening the contact plates, it is necessary to make sure that the top clamping of the electrode is effective (when using, for example, Wisdom ribbons or friction brakes).

5. MAINTENANCE

5.1 When servicing the furnace (hearth or walls), suitable safety precautions shall be taken to prevent the electrodes from dropping into the shell due to the electrode holder falling or to a fault connection between the electrode holder and the electrode.

5.2 The operators responsible for flushing the cooling water pipes of the furnace (for instance, with a hydrochloric acid solution) shall be adequately protected (rubber gloves, clear goggles closed around the sides, etc).

6. SPECIAL ELECTRICAL HAZARDS

6.1 When carrying out electric welding of the electrical secondary connections, access to the arc furnace transformer primary connections shall not be possible, since by energizing the secondary connections a high voltage shall also be produced on the primary connections.

6.2 For arc furnaces other than submerged arc furnaces, when examining or working on the secondary circuits of current transformers and connected instruments and control devices, the terminals of such current transformer secondaries shall be short-circuited and earthed.

NOTE — For submerged arc furnaces, this requirement is not applicable when extending the self-sintering electrodes, as electric power to the furnace is switched on. Nevertheless, this requirement is applicable when examining or working on the secondary of the transformer when electric power to the submerged arc furnace is switched off.

**INDIAN STANDARDS
ON
INDUSTRIAL ELECTRO-HEATING EQUIPMENT**

IS:

- 1885 (Part LI/Sec 1)-1979 Electrotechnical vocabulary: Part LI Industrial electro-heating, Section 1 General terms
- 1885 (Part LI/Sec 2)-1979 Electrotechnical vocabulary: Part LI Industrial electro-heating, Section 2 Resistance heating
- 8992-1978 Test methods for induction furnaces with submerged channels
- 9021-1978 General test conditions for industrial electro-heating equipment
- 9029-1978 Methods of tests for batch furnaces with metallic heating resistors
- 9050-1979 Nominal dimensions of cylindrical machined graphite electrodes with threaded sockets and connecting pins for use in electric arc furnaces
- 9080 (Part I)-1979 Safety requirements in electro-heat installations: Part I General requirements
- 9080 (Part II/Sec 1)-1979 Safety requirements in electro-heat installations: Part II Particular requirements for resistance heating equipment, Section 1 Protection in direct resistance heating installations
- 9080 (Part III)-1979 Safety requirements in electro-heat installations: Part III Particular requirements for mains and medium frequency induction furnace installations